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This paper examines how Marine Corps rotary wing aviation is lacking in its ability to conduct medical support helicopter operations. As an example, during Operation Iraqi Freedom, Marine Corps rotary wing aviation was quite successful in executing medical evacuation (MEDEVAC) and casualty evacuation (CASEVAC) missions. However, the primary reason for this is that various aspects of the operating environment in Iraq made such missions relatively easy in comparison to other areas of operation such as Afghanistan. Ultimately, Army and Air Force units have proven much more capable and successful in Afghanistan. As America's "force in readiness" the Marine Corps is expected to deploy all over the world and conduct operations in any environment. Yet, its aviation component is not suited to conduct the full spectrum of medical support helicopter operations. Changes must be made to its organization, training, equipment, and doctrine in order for the Marine Corps to be successful in executing such missions in conflict zones around the world.

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United States Marine Corps
Command and Staff College
Marine Corps University
2076 South Street
Marine Corps Combat Development Command
Quantico, Virginia 22134-5068

MASTER OF MILITARY STUDIES

THE EVOLUTION AND FUTURE OF MARINE CORPS MEDICAL EVACUATION AND CASUALTY EVACUATION OPERATIONS

SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF MILITARY STUDIES

MAJOR BRIAN SANTUCCI

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Oral Defense Committee Member: Eric Shibuya, PhD
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Executive Summary

Title: The Evolution and Future of Marine Corps Medical Evacuation and Casualty Evacuation Operations

Author: Major Brian Santucci, United States Marine Corps

Thesis: Medical support helicopter operations have been a mainstay in the American military since the Korean War. Yet, over the years the capabilities of each service have diverged significantly. In comparison to the Army and Air Force, Marine Corps rotary wing aviation is lacking in its ability to conduct medical support helicopter operations, and will need address multiple deficiencies in order to provide adequate care of its personnel during expeditionary operations.

Discussion: During Operation Iraqi Freedom, Marine Corps rotary wing aviation was quite successful in executing medical evacuation (MEDEVAC) and casualty evacuation (CASEVAC) missions. However, the primary reason for this is that various aspects of the operating environment in Iraq made such missions relatively easy in comparison to other areas of operation such as Afghanistan. Ultimately, Army and Air Force units have proven much more capable and successful in Afghanistan.

Conclusion: As America's "force in readiness" the Marine Corps is expected to deploy all over the world and conduct operations in any environment. Yet, its aviation component is not suited to conduct the full spectrum of medical support helicopter operations. Changes must be made to its organization, training, equipment, and doctrine in order for the Marine Corps to be successful in executing such missions in conflict zones around the world.

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Preface

This paper is written about a mission that can be summarized in two simple words: saving lives. Throughout my career I've been intimately involved in the Marine Corps' efforts to utilize helicopters to provide medical care and transportation of the sick and injured. Over time, my various experiences, as well as interactions with others, led me to the conclusion that something was missing in the way the Marine Corps approaches this mission. Specifically, the Marine Corps lacks dedicated medical helicopters, its squadrons are not manned appropriately, and peacetime training is virtually non-existent. While conducting research for this paper, I also discovered that other services, though pursuing the same goal, have a very different approach. These differences, rooted in both doctrine as well as organizational history, have great value to offer when considering the future of Marine aviation. Ultimately, the expeditionary ethos of the Marine Corps and the austere and challenging environments in which it fights means that it has the most to lose in failing to develop a robust medical aviation capability.

I would like to give special thanks to the corpsmen, crew chiefs, rescue swimmers, aerial observers, maintenance personnel, and fellow pilots which I was very fortunate to have had the honor and privilege of serving with. Ultimately, this paper was written for them, as well as the soldiers, sailors, airmen, Marines, and civilians that they continue to support. Their hard work, perseverance, dedication, and bravery truly exemplify the creed "That Others May Live."

"If a man is in need of rescue, an airplane can come in and throw flowers on him, and that's just about all. But a direct lift aircraft could come in and save his life."

- Igor Sikorsky, pioneer of modern rotary wing aviation

INTRODUCTION

Since the first helicopter rescue towards the end of World War II, the unique capabilities of helicopters have been used in life saving missions around the world. Over time, various military and civilian agencies have developed equipment and procedures in an effort to improve a seemingly simple and straightforward process: land where an airplane cannot, pick up patients, provide en route care, and rapidly deliver them to advanced medical care in an effort to save lives. It should be no surprise, then, that the complexities of modern warfare can make this mission extremely difficult. Despite these challenges, nearly every modern military in the world possesses at least a basic capability of performing life saving missions in a combat environment. From Korea and Vietnam to the more recent conflicts in Iraq and Afghanistan, the U.S. military has a long and distinguished history of rescuing wounded personnel, downed airmen, and others in need in war zones around the world. Additionally, military units have also been used in times of crisis for civilian life saving operations and humanitarian missions, often in countries that do not possess advanced medical aviation assets.

However, despite the importance of this mission and the necessity to do it right, there are no standards across the services for how this mission is conducted. In fact, there are significant differences in how each service organizes and trains its personnel, what equipment is used, and how the missions are performed. Ultimately, the overall mission of each service must dictate, at least to some extent, the organization, equipment, training, and doctrine for the use of helicopters to provide medical care and transportation. Yet, the differences between each service highlight certain deficiencies in Marine aviation, such as how its medical personnel are assigned and

trained and how its helicopters are equipped. However, this is not to suggest that Marine helicopters and aircrew are not capable of performing this mission, as they were quite successful in Iraq. Yet, despite its success in Iraq, Marine rotary wing aviation needs to improve its capability to conduct life saving missions by improving its organization, training, and equipment and updating its doctrine. Failure to evolve in these areas could ultimately result in the needless loss of life of America's most precious military resource: its soldiers, sailors, airmen and Marines serving on the frontlines around the world. This paper will examine recent Marine Corps helicopter operations in Iraq and Afghanistan and compare them to two other services: the U.S. Army and the U.S. Air Force. From this comparison, conclusions and recommendations will be made regarding how Marine Corps aviation can improve its capability to conduct life saving missions, thereby enhancing its expeditionary capabilities and its ability to be successful in the joint operating environment.

DEFINITIONS

Just as each service has a different way of performing life saving missions, there are different types of missions that fall within this broad category. Specifically, the two major types of life saving missions are Medical Evacuation (MEDEVAC) and Casualty Evacuation (CASEVAC). According to Joint Publication 4-02, Health Service Support, MEDEVAC refers to "dedicated medical evacuation platforms staffed and equipped to provide en route medical care using pre-designated tactical or logistic aircraft, boats, ships, and other watercraft temporarily equipped and staffed with medical attendants (MAs) for en route care."[1] CASEVAC, on the other hand, is the "unregulated movement of casualties aboard ships, land vehicles, or aircraft."[2] Though these doctrinal definitions provide a starting point, operationally there are significant differences between the two missions. In theater, MEDEVAC usually

denotes patient movement from one level of care to another. The patient is usually stable, and is merely being transported to a higher echelon of medical care. The landing zone is normally prepared to receive helicopters and designated well in advance, and medical personnel are usually on hand for patient turnover. CASEVAC, however, involves transporting wounded personnel *from a combat zone* to medical care. Aircraft performing CASEVAC may be flying to the point of injury, landing in unprepared zones while being subjected to enemy fire, and picking up patients that have received little or no medical attention. In other words, the difference between a MEDEVAC and a CASEVAC can be extremely significant to those performing such missions.

Two other terms related to MEDEVAC and CASEVAC are Search and Rescue (SAR) and Combat Search and Rescue (CSAR, now generally denoted by the term Personnel Recovery, or PR). SAR is just what it says: searching for personnel and rescuing them. Technically, any helicopter can be used for SAR, though special equipment and training can greatly increase its effectiveness. Additionally, most SAR units fly with medical equipment and personnel trained in its use, with the underlying assumption that anyone needing rescue may require medical attention as well.[3] CSAR (or PR) is a subset of SAR, with the primary distinction that it is performed in a hostile environment. Because of this, the tactics utilized in CSAR/PR missions are quite different than those used in SAR. Multiple types of aircraft may be needed including fixed wing escorts and command and control aircraft.[4] Yet another term is the Marine Corps' Tactical Recovery of Aircraft and Personnel, or TRAP. Though this may seem similar to CSAR/PR, TRAP missions are "conducted only when survivors and their locations are confirmed."[5] Ultimately, MEDEVAC and CASEVAC are often considered subsets of SAR, CSAR/PR, and TRAP: the location of those needing assistance is either known (TRAP) or

unknown (SAR, CSAR/PR) and either in friendly territory (SAR) or enemy territory (CSAR/PR, and TRAP). These missions all have at least one thing in common: combining the flexibility of helicopters with various levels of medical capability to save lives.

Thus, there are many different types of missions in which the military will utilize helicopters for providing transportation and care of personnel. Those not familiar with the distinctions often use the terms interchangeably or incorrectly, which can create confusion. Adding to the confusion is that sometimes the distinction between them (especially between CASEVAC and MEDEVAC or CSAR/PR and TRAP) is a matter of interpretation. Therefore, how a unit is manned, trained, and equipped can determine how successful it will be in accomplishing these missions. Some services have tailored their personnel, equipment, and training to specific missions: the Navy is well suited for SAR (particularly overwater SAR), the Army has excellent MEDEVAC capability, and the Air Force is the lead service for CSAR/PR.[6] The Marine Corps, on the other hand, with its smaller force structure, limited aviation assets, and operational focus on warfighting, does not maintain a robust capability to conduct these missions. Just prior to the start of Operation Iraqi Freedom, the Marine Corps was not organized to be successful at any of them.

OPERATION IRAQI FREEDOM

Before the invasion of Iraq in March 2003, Marine Corps helicopter squadrons placed little to no emphasis on the CASEVAC/MEDEVAC mission. Helicopters capable of performing such missions were (and still are) categorized as Assault Support assets. Within the broad subset of missions doctrinally listed under Assault Support, neither MEDEVAC nor CASEVAC are listed. Instead, they are both listed under Air Evacuation, which is broadly defined as "the transportation of personnel and equipment from [forward operating bases] or remote areas."[7]

Though CASEVAC is mentioned, there is no succinct definition, nor is there a definition of MEDEVAC. This lack of a cohesive definition of either CASEVAC or MEDEVAC within Marine Corps doctrine led to severe shortfalls in the capability to perform such missions, though during peacetime operations such shortfalls went unnoticed.

For example, prior to Operation Iraqi Freedom, Marine Aircraft Group 39 (MAG-39) was tasked with providing SAR support to the Marine Corps Air Ground Combat Center (MCAGCC) in 29 Palms, California.[8] This involved a helicopter (either a UH-1N or CH-46E) and crew maintaining a 24-hour alert while the firing ranges were being utilized. However, the crews did not include a corpsman, nor was any special medical equipment carried. This is due to the fact that although MAG-39 had corpsmen assigned to it (as does each MAG in the Marine Corps), they were not trained to perform medical procedures while flying in helicopters, nor were they expected to.[9] With no such expectation, there was simply no need to train accordingly, or have access to the appropriate medical equipment and gear that would need to be carried on the helicopter. Furthermore, Marine aircrews were not trained in search procedures or how to communicate with other first responders. Thus, MAG-39 ostensibly supported MCAGCC 29 Palms with SAR assets, but a lack of trained personnel and equipment greatly limited its capability.

When MAG-39 deployed overseas in support of Operation Iraqi Freedom, the CH-46E squadrons were assigned the mission of providing CASEVAC support to various Regimental Combat Teams (RCTs). Other MAGs with CH-46E squadrons were given the same mission. Thus, every RCT would have a section (two helicopters) permanently assigned to CASEVAC duty. Additionally, MAG-39 was augmented with the Army's 498th Medical Company to provide MEDEVAC support with their UH-60 helicopters.[10] Due to the limited number of

corpsmen within MAG-39, it was augmented with corpsmen from other units. However, the experience level between these corpsmen varied greatly: some were SAR Corpsmen in the Navy that were specially trained to provide medical support while flying in helicopters; others had no aviation experience at all. Their medical expertise ranged from fully qualified paramedics to corpsmen that merely had basic emergency medicine training. Finally, there was no standard for what medical equipment to carry on the helicopter. Therefore, corpsmen equipped their helicopters based on a combination of what their experience suggested would be good to have and what they could beg, borrow, or steal from other units.

Despite the disorganized nature of this ad hoc, "come as you are" situation, Marine Corps helicopter squadrons performed quite well. Force commanders assigned three squadrons (HMM-161, HMM-286, and HMM-364) to a rotation to cover CASEVAC and MEDEVAC operations for all forces serving within Al Anbar province (there were other Marine squadrons based at other locations that performed some CASEVAC and MEDEVAC missions, but it was not their primary mission).[11] Based in Al Taqaddum, which is located between Fallujah and Ramadi, from 2004 through 2009 these three squadrons (which were at times augmented with Army helicopters for MEDEVAC support) flew thousands of medical sorties, accumulating thousands of flight hours in life saving efforts. For example, during a seven month period from February to August 2005, HMM-364 completed 266 urgent CASEVAC missions and 3,169 priority or routine MEDEVAC missions (patients are classified as urgent, priority, or routine, depending on the nature and severity of their injuries). From August 2006 to February 2007, HMM-364 transported 715 urgent patients, 187 priority patients, and 1,317 routine patients, accumulating 6,373 flight hours. Another squadron, HMM-161, executed 126 urgent CASEVAC missions in April 2004 alone, while logging 563.4 flight hours.[12] Thus, significant effort went into

generating the capability to fly a substantial number of hours dedicated to providing medical support, even though Marine Corps Assault Support doctrine speaks very little about these types of missions and these units were not trained or equipped to do so prior to the start of hostilities.

Logically, it is reasonable to infer that, when considering the success of Marine helicopter squadrons performing CASEVAC and MEDEVAC missions in Iraq, it is acceptable to dedicate minimal resources to maintaining this capability in peacetime and merely generating it as the need arises. From this, it is also reasonable to assume that not having and maintaining a standard for the organization, training and equipping of Marine helicopter squadrons for CASEVAC and MEDEVAC is acceptable as well. These inferences, however, are both incorrect. Success in Iraq was closely related to the operating environment. This is not to say that Marine helicopter crews did not face challenging conditions or situations in Iraq, or that what they did was "easy." However, certain aspects of the operating environment meant that success would be easier in Iraq than it would be in other operating environments.

First, most of Iraq (and nearly all of Al Anbar province) is flat. Though many of the landing zones were extremely small and often dusty, and at times were located in urban environments with associated obstacles, Marine helicopter crews did not face the challenges of dealing with significant terrain such as steep mountains, cliffs, and ravines. Second, although the high temperatures of Iraq did significantly degrade aircraft performance, the elevation of the terrain throughout Anbar province was close to sea level and did not affect aircraft performance at all. Furthermore, the battlespace geometry of Iraq facilitated success as well, since the distances flown on most missions throughout Al Anbar province were relatively short. At 120 knots, a CH-46E can fly from Fallujah to Al Taqaddum in under ten minutes. Flights from Ramadi to Al Taqaddum take less than 15 minutes. So, not having extensive medical training or

equipment was often not a significant issue, since the time available to work on patients prior to dropping them off at the receiving medical facility was so limited.

Perhaps most important is that as the war progressed, the perceived enemy threat to helicopters diminished. This changed both the tactics and structure of how MEDEVAC and CASEVAC missions were performed, and ultimately led to blurred lines between them. Since CASEVAC missions had the potential to encounter enemy resistance, it was critical (at least initially) to use armed helicopters. During the day, Marines conducting CASEVAC or MEDEVAC missions flew as either a "1 and 1" package or a "2 and 2" package, meaning one or two armed CH-46s escorted by one or two Marine AH-1attack helicopters (each CH-46 had its own escort, and the number of CH-46s to be utilized for each mission was based on the number of casualties). At night there was a tactical advantage provided by Night Vision Goggles (NVGs) and the enemy's lack thereof, so it was considered tactically sound to fly without escorts. As the threat level lessened, unarmed Army UH-60s were able to perform more and more CASEVAC missions, first with escorts, then later without escorts. Thus, in 2004 armed Marine CH-46 helicopters flew escorted during the day, and always flew as a flight of two CH-46 helicopters at night. By September 2005, unarmed Army UH-60s provided CASEVAC and MEDEVAC coverage at night (escorted by AH-1s), and by 2009 unarmed and unescorted Army UH-60s performed CASEVAC and MEDEVAC missions both night and day. Between the flat terrain, compact battlespace geometry, and a perceived reduction in the enemy threat, the operating environment in Iraq, though not "easy," should be considered more permissive than other operating environments such as Afghanistan.

CHALLENGES IN AFGHANISTAN

With its high terrain and rugged, mountainous topography, Afghanistan presents significant challenges to helicopter operations. Massive mountains, steep ravines, and narrow valleys, combined with extreme elevations that can exceed 23,000 feet combine to form one of the most challenging operating environments for helicopters in the world.[13] Add high temperatures (which further reduce aircraft performance), darkness, dust, and an enemy threat and there are very few helicopters capable of operating in such conditions. Another challenge is the size of Afghanistan. The numerous remote locations where NATO forces are operating, coupled with the handful of bases that operate CASEVAC or MEDEVAC helicopters, leads to a situation where medical assistance and transportation might take quite some time to arrive.[14]

THE GOLDEN HOUR

In many ways, this is the crux of the problem: the sooner trauma patients receive advanced medical care the higher their survival rate. This concept, known as the Golden Hour, refers to "the time from injury to definitive care, during which treatment of shock and traumatic injuries should occur because survival potential is best...After the first 60 minutes, the body has increasing difficulty in compensating for shock and traumatic injuries."[15] This concept is considered critical in both military and civilian medicine, and a medical system designed to support it resulted in some amazing successes in Iraq, where in some instances the die-of-wound rates were around 1 percent.[16] Because of these successes, Defense Secretary Robert Gates "has been adamant that troops in Afghanistan, where the craggy terrain makes medical evacuations difficult, get help as quickly as those in Iraq."[17] Yet, these recent medical successes on the battlefield have caused some, such as Navy trauma surgeon Captain Joseph Rappolo, to question the validity of the Golden Hour concept: "Seventy minutes to the right place is better than fifty

minutes to the wrong place."[18] However, these success rates are likely linked to the availability and location of forward-based advanced medical units such as Shock Trauma Platoons (STPs), Surgical Shock Trauma Platoons (SSTPs), and Forward Resuscitative Surgical Squads (FRSSs).[19] Regardless of how close these advanced medical units are to the point of injury, patients still require transportation. Furthermore, since time is clearly a factor (whether it's 50 minutes or 70 minutes), due to terrain, road conditions, hostile forces along the route and numerous other factors, helicopters may be the only viable option in many cases.

Based on the challenges associated with helicopter operations in Afghanistan, most Marine Corps helicopters are not capable of performing CASEVAC and MEDEVAC missions in such an extreme environment. In fact, a report on Marine Expeditionary Brigade - Afghanistan (MEB-A) operations from the Marine Corps Center for Lessons Learned states "Airborne MEDEVAC was provided exclusively by U.S. Army, U.S. Air Force, and United Kingdom aviation assets. With increasing numbers of Marines deploying to the MEB-A AO, the numbers of MEDEVAC aircraft must be increased correspondingly."[20] When examining why Marine helicopters are *not* capable of providing MEDEVAC support in Afghanistan, it is necessary to study what makes other services able to do so.

U.S. Army MEDEVAC

The U.S. Army has been using helicopters to provide medical transportation since the Korean War. Using modified Bell 47s, Army pilots transported wounded soldiers to awaiting MASH units for treatment. Later, in Vietnam, the venerable UH-1 took on the MEDEVAC role and earned the moniker "DUSTOFF" due to the amount of dirt displaced when taking off and landing.[21] The UH-1 was eventually replaced by the UH-60 Black Hawk, which has seen significant upgrades since it first entered service. Ever evolving, the Army has always seen the

need to be able to evacuate its soldiers. This attitude was best summarized by Army Lieutenant General James D. Thurman in January 2010, while speaking at the Army Aviation Symposium and Exhibition: "We've got to get our men and women off the battlefield - that's non-negotiable."[22] This philosophy has shaped Army MEDEVAC units into highly capable battlefield assets that, in many respects, are superior to their counterparts in Marine aviation.

In his article "Saving Lives and Limbs", U.S. Navy doctor and combat surgeon Captain Michael Vengrow succinctly summarizes the primary difference between Marine aviation and Army aviation: the Army has a dedicated MEDEVAC helicopter while the Marine Corps does not. The primary advantage of having a dedicated MEDEVAC helicopter is that it enables the aircraft to be equipped specifically to provide medical support.[23] The Army UH-60s are so equipped, and have provisions for integrated litter stations as well as a ventilator. The advantages of the UH-60 platform do not end there, however. They have a service ceiling of over 20,000 feet, enabling them to perform well at high altitude. The latest version, the UH-60Q/HH-60L variant, includes airway suctioning equipment, onboard oxygen generating equipment, and an electric rescue hoist.[24] Finally, if needed, they can be pressed into service as a SAR or even CSAR asset, with their Forward Looking Infrared (FLIR) to aid in searches and provisions for the addition of external fuel tanks to increase mission radius. No Marine helicopter currently has the equipment and performance comparable to the Army's UH-60 MEDEVAC helicopters.

From a personnel standpoint, Army MEDEVAC units are built from the ground up to provide medical support. Of primary importance is that their flight medics are rigorously screened and trained. Prerequisites for the Army's Flight Medic Course in Fort Rucker, Alabama include a minimum of one year as a combat medic and being a certified Emergency

Medical Technician (Basic). Upon graduating from the course, Army Flight Medics are qualified in International Trauma Life Support (ITLS), Advanced Cardiac Life Support (ACLS) and Pediatric Education for Prehospital Professionals (PEPP). Additionally, throughout the course they are exposed to aviation operations, ensuring they can perform as members of the crew on aircraft.[25]

Not only does the Army have the right equipment, as well as properly trained personnel to use the equipment, they are also organized for success. Army MEDEVAC units are currently organized into MEDEVAC Companies with 12 aircraft each (Marine CH-46 squadrons also normally have 12 aircraft assigned). However, they are permitted to have up to 1.5 flight medics per aircraft, for a total of 18.[26] The key difference between Army MEDEVAC units and Marine CASEVAC is that these flight medics, in addition to being thoroughly trained, are permanently assigned to the unit. They have a Military Occupational Specialty (MOS) of 68WF (Flight Medic), which means that it is specific career field. The Marine Corps, on the other hand, uses Navy Corpsmen that are not permanently assigned to the squadron and may or may not have any specific aviation training prior to being assigned as a CASEVAC corpsman.

With a highly capable helicopter, excellent medical equipment, trained personnel, and a focus on the medical aspects of the mission, Army MEDEVAC units are quite capable. However, it must be stressed that they are capable of performing *MEDEVAC* missions, not CASEVAC, for one simple reason: they are unarmed. Though it is certainly possible for unarmed helicopters to conduct CASEVAC missions by flying with escorts, any time helicopters are in close proximity to hostile forces it is generally preferred that they be armed. As for why the Army chooses not to arm their MEDEVAC helicopters, per the Geneva Convention, Army MEDEVAC helicopters are emblazoned with large red crosses on white backgrounds and are

designated as medical transports. As such, they are unable to take part in any hostilities and are therefore unarmed.[27] Though Army MEDEVAC helicopters have certainly flown in hostile conditions, both with and without escorts, the likelihood of insurgents, terrorists, or other non-state actors honoring the Geneva Convention and granting them protection in the performance of their duties is extremely remote, making such helicopters a less than ideal CASEVAC platform on today's battlefields.

U.S. Air Force CSAR

Like the Army, the U.S. Air Force has a long and distinguished history of using helicopters for medical support and rescue. Shortly after World War II, the Air Rescue Service (ARS) was created. Utilizing Sikorsky H-5 and H-19 helicopters, the ARS transported 9,219 personnel to safety during the Korean War, 846 of which were rescued behind enemy lines.[28] Following the Korean War, the Air Force was tasked with creating and manning Rescue Coordination Centers throughout the United States (as well as joint centers overseas), with the responsibility of coordinating all land-based search and rescue missions. During Vietnam, the Air Force developed special tactics and techniques that would enable them to perform CSAR in the hostile jungle environment. Most notably, they developed and employed the HH-3 Jolly Green and HH-53 Super Jolly Green, which were the only helicopters that "had the size, range, speed, performance, armor protection, defensive systems, and guns to properly do the CSAR mission."[29] Currently, Air Force CSAR units fall under the Air Force Special Operations Command (AFSOC), and for a variety of reasons are considered the most capable asset in current operations in Afghanistan.

The Air Force Special Operations Command currently uses two types of rotary wing aircraft: the new CV-22 (the Air Force version of the Marine Corps MV-22 tilt-rotor aircraft,

which replaced all MH-53 Pave Low helicopters in 2008) and the venerable HH-60 Pave Hawk. However, the CV-22's primary missions are "long-range infiltration, exfiltration and resupply missions for special operations forces."[30] Furthermore, due to their inability to conduct hoist operations and lack of defensive armament, they are not considered an ideal platform for CASEVAC or CSAR missions.[31] Thus, the primary Air Force helicopter for medical support is the HH-60 Pave Hawk. Although similar to the Army's UH-60 Black Hawk, the Pave Hawk does possess distinct and significant differences. It has an external rescue hoist for personnel recovery in jungle or mountainous regions (such as Afghanistan), as well as weather radar and terrain avoidance radar for flying in poor weather. It also has an aerial refueling probe, greatly increasing its mission radius and endurance. Most importantly, unlike Army MEDEVAC helicopters, it is armed. Carrying either two 7.62 mm mini-guns or two XM-218 .50 caliber machine guns, it possesses an organic self-defense capability useful while operating in hostile enemy environments. However, it can only carry two patients (unlike the Army UH-60, which can carry four) and due to the extra equipment it carries it is much heavier and does not have the performance at high altitude of the UH-60.

Perhaps the most significant difference between Air Force CSAR units and other units that perform MEDEVAC and/or CASEVAC is that Air Force Pararescuemen initially receive significantly more medical training than Army flight medics or Navy corpsmen. Specifically, Air Force Pararescuemen are fully qualified and nationally registered Paramedics. For comparison, in American trauma medicine first responders are categorized into three primary types: Emergency Medical Technician-Basic (EMT-B), EMT-Intermediate (EMT-I), and Emergency Medical Technician-Paramedic (EMT-P).[32] Of these, EMT-P is the highest certification available. Paramedics are capable of performing numerous life saving procedures

that an EMT-B or EMT-I cannot, such as IV therapy, intubation, needle decompression for tension pneumothorax (also known as a "sucking chest wound," the third most common wound sustained in combat requiring a CASEVAC), and advanced pharmacology.[33] Thus, from a pure training standpoint, the Air Force possesses the most highly trained medical personnel when compared to the Army and Navy, as Air Force Pararescuemen are trained as Paramedics and are required to maintain a Paramedic qualification throughout their career. [34]

With an extremely capable (and armed) helicopter and the best trained medical personnel, the U.S. Air Force sets the standard among the services for utilizing helicopters to perform CASEVAC, MEDEVAC, and CSAR missions. In fact, in a study conducted by the Joint Personnel Recovery Agency, which looked at the capabilities of all services, the Air Force came out on top:

> The 11 areas looked at included the training of medics, communications gear, night operations, ability to launch a mission on short notice, urban operations and capability to rescue people trapped at high altitude...The Air Force got the highest scores in seven categories and second place in three.[35]

However, there are some organizational challenges that must be overcome. The first is that Air Force CSAR assets are a very small part of the Air Force. Currently, there are only about 100 HH-60 Pave Hawk helicopters in the inventory, compared to the 171 needed based upon a government study.[36] Because of their exceptional capabilities, they are some of the most deployed assets in the American armed forces, and currently have a 1:1 deployment to dwell ratio. This, in turn, has a generated such a high utilization rate that the aircraft are rapidly approaching the end of their service life. The program to find a suitable replacement aircraft, called CSAR-X, was cancelled by Secretary of Defense Robert Gates in April 2009.[37] With no replacement aircraft in sight, it is unknown how long the Air Force will be able to sustain its MEDEVAC and CASEVAC support to the other services.

The Current State of Marine Corps MEDEVAC/CASEVAC Capability

In comparing Marine Corps capabilities with the other services, it is first necessary to compare the types of helicopters each service uses. The Marine Corps currently fields four different types of helicopters capable of performing MEDEVAC and CASEVAC missions, to varying degrees. However, none of them are as capable as the H-60 platform used by the Army and Air Force. The venerable CH-46, though reliable, does not have the performance at altitude of the UH-60. Its replacement, the MV-22, is poorly armed, too fast for escorts, susceptible to brownout conditions (which make landings difficult, if not impossible), and is not suited for hoist operations.[38] The CH-53, though extremely powerful and capable of flying at high altitudes with little effect on payload, is too big to land in many landing zones, does not have a hoist (and even if it did, its large rotor downwash would make hoisting extremely challenging and dangerous), and is also susceptible to brownout conditions. The UH-1Y, which is slowly replacing the older UH-1N, is armed, fast, has advanced avionics (including FLIR), and has hoist capability. In many respects, its performance matches or exceeds the UH-60, with one exception: cabin space. Like the Air Force HH-60, it only has room for (at most) two littered patients.

From a medical training standpoint, the Marine Corps relies on the Navy to provide corpsmen. However, their training is not as robust as Air Force paramedic training or Army flight medic training. Currently, corpsmen performing CASEVAC and MEDEVAC missions with the Marine Corps are essentially regularly combat-trained corpsmen, with the exception of having attended a two week course which includes a few helicopter familiarization flights on a CH-53 or MV-22. In fact, the Navy recently dropped the requirement for all corpsmen to maintain EMT-B certification, since Navy bases now outsource their EMS personnel needs.[39] Finally, Army flight medics and Air Force Pararescuemen are not only assigned to specific

squadrons, they are an integral part of the crew during both peacetime training and war. While this may not seem critical, the more operational experience medical personnel can get while working in the back of a helicopter, the better off their patients are.[40] These training deficiencies were recognized in 2003 by the Naval Health Research Center:

> Personnel for long-range missions would be limited to search-and-rescue hospital Corpsmen...who already possess many of the advanced clinical skills required by the mission, as well as aircrew qualifications. For short-range CASEVAC missions, the SON [Statement of Need] specifies the use of medical specialist hospital corpsmen assigned to the Marine Corps...some of whom may or may not have aircrew qualifications. Corpsmen for both missions will require additional training, though the extent of the training for both short- and long-range missions will depend on the individual corpsman's existing level of training. Additional skills needed may include rapid sequence intubation, needle decompression of the chest, ventilatory support and more advanced pain control.[41]

Thus, compared to their Army and Air Force counterparts, the training and certification requirements for Navy corpsmen flying in Marine helicopters are minimal at best.

The medical equipment carried on Marine helicopters varies as well. An attempt to standardize this was made in 2004, and the Authorized Medical Allowance List (AMAL) 648: Casualty Evacuation System was created in 2008.[42] However, the Marine Corps and its Navy corpsmen have been slow to implement it. From a corpsman currently serving in Afghanistan:

> "As far as I know there is no standard for medical equipment carried on the [aircraft]...OEF when I got out here [to Afghanistan] the previous CASEVAC Corpsman would only fly with the medbags. Since I have been here I have built up the load out similar to what we were using in SAR to include two O_2 tanks, PropPaq Monitor, Pelican Case 1690 to contain those items, 1 Med Curtain, [and] 1 Jump bag per [aircraft]."[43]

Between a lack of properly trained medical personnel and a lack of standardized medical equipment, the Marine Corps lags far behind both the Army and Air Force in its medical capability.

The biggest challenges the Marine Corps faces in improving its medical helicopter capabilities are its institutional mindset and doctrine. From an unsigned and unofficial position paper from Marine Aviation officials within the Pentagon:

> "The Marine Corps cannot afford mission exclusivity with its assault support assets due to the limited space available to ship based forces: assault support assets must remain multi-role capable...The Marine Corps should be wary of any initiative...which may result in additional joint tasking, changes to the Corps' roles and missions, and requisite structure changes to USMC medium lift squadrons to facilitate augmented en route medical capabilities...The Marine Corps' assault support assets should continue to perform their missions as currently defined. Furthermore, the Marine Corps should embrace the inherent limitations associated with a multi-role amphibious force and ensure the joint community knows the Corps' limitations relating to MEDEVAC. Finally, the Corps' should maintain its position that it can perform CASEVAC where needed, but relies on the more robust capabilities of the USA and USAF for theater medical services in prolonged land combat."[44]

Although this is not an official position, it serves to highlight the mindset within the Marine Corps that exists today. However, its reasoning is inherently flawed. As Navy combat surgeon Captain Vengrow rhetorically asks, "Are Army infantry soldiers more important than Marines as human beings or as components of U.S. defense strategy?"[45] Although the answer is clearly a resounding "no!" the Marine Corps feels that it should be able to rely on other services to provide medical helicopter support. Yet, this conflicts with historical precedent, as Marine helicopters provided MEDEVAC and CASEVAC support to all forces in Al Anbar province for several years. Furthermore, the Department of the Navy's Sea Power 21 doctrine calls for Marine forces to operate up to 400 miles from their amphibious ships, in littoral areas where Army and Air Force units will likely be unable to provide support.[46] Based on current equipment, personnel, and organization, the Marine Corps will have a difficult time helping wounded Marines during such operations.

Recommendations: The Way Ahead

While it may be true that due to its amphibious nature it would be difficult for the Marine Corps to field a dedicated medical helicopter, this should not be used as an excuse for the current state of affairs that exist within Marine aviation. There are numerous opportunities to improve the Marine Corps' capability to provide MEDEVAC, CASEVAC, TRAP, and even CSAR. Perhaps the most important thing is simply for the Marine Corps to recognize its current limitations, along with the capabilities that other services have, and then recognize that it can (and needs) to do better. Though the Marine Corps may not have the resources available to the Army and Air Force, Marines generally do not accept being considered inferior to other services, nor should they when it comes to these missions. Furthermore, as an expeditionary force, the Marine Corps must recognize that it must be capable, at least to some degree, of performing all of these missions, including CSAR.

Also important, and something, which would be beneficial for *all* services, is to develop clear and concise joint definitions for CASEVAC, MEDEVAC, CSAR/PR, TRAP, and SAR helicopter operations. These definitions should start with the principle that these missions, though different, also have similarities and are in many ways hierarchical (i.e., if you can do CSAR, you can do all the missions, if you can do CASEVAC you can do MEDEVAC, etc...See Appendices B, C). Once definitions have been created that all services can agree on, a list of requirements for each mission set should be created. This will enable each service to understand what standards it needs to meet in order to properly man, train, and equip for their specific role within the joint operating environment (see Appendix C). Also applicable to the joint arena, the U.S. Air Force and U.S. Army must restructure their helicopter aviation assets. The Air Force should immediately seek a viable replacement for its aging HH-60 fleet and field it quickly while

the Army should take a portion of its MEDEVAC helicopters and configure them for true CASEVAC operations by removing the Red Cross emblem and adding crew served weapons for a self defense capability.

As for the Marine Corps, there are four specific steps it must take to improve its ability to provide care and transportation of wounded personnel via helicopter. First, it must ensure all corpsmen assigned to a MAG are trained to act as aircrew. This would entail each corpsman being medically screened for aviation duty, then scheduled to accumulate an appropriate number of hours in each type of helicopter within their assigned MAG. While flying in the back of helicopters they should practice basic medical procedures and familiarize themselves with the medical equipment carried.

Next, these corpsmen must receive more medical training. This training should be, at the very least, equivalent to the training at Army flight medic school. In fact, Navy Search and Rescue corpsmen already attend this school, so the Navy and Marine Corps would simply need to fund additional school seats for MAG corpsmen to attend. Ultimately, the goal would be to have every single corpsman at the MAG be a highly trained medical professional that is comfortable with performing trauma medicine and other medical procedures onboard a helicopter. Though each corpsman would still be required to perform their regular clinical duties, they should be prepared to deploy with any squadron in their MAG to provide aviation medical support in any environment.

The next step is to standardize the aviation medical equipment organic to each squadron. Though AMAL 648 is a standard setup for the MV-22 and CH-53, there is no equivalent for the UH-1Y. With the UH-1Y expected to take over many of the missions of the CH-46, not having a standardized medical kit for the UH-1Y greatly reduces its ability to conduct medical support

missions. However, creating such a kit is only half the battle. It is just as important to actually purchase and field these kits to the appropriate squadrons. Furthermore, these kits must be used regularly in training, and inspected and inventoried on a regular basis.

Finally, the Marine Corps needs to incorporate hoist training in all fleet squadrons with UH-1Y aircraft. Having a hoist capability adds significant operational flexibility, both for medical and rescue aspects as well as regular insertion and extraction of personnel. The ability to perform hoist operations enables Marines to be retrieved from mountain tops as well as heavy jungle foliage, greatly expanding the environment in which Marines can operate without the fear of not being able to be rescued. Unfortunately, there is a great deal of misunderstanding regarding hoist operations. From a study prepared for the House Armed Services Committee by the Marine Corps Center for Lessons Learned: "Hoisting operations including those involved in aero medical evacuation are inherently dangerous."[47] This is simply not correct. Though hoist operations can be dangerous and are not without risk, so are many other military operations that are performed every day. In fact, the Marine Search and Rescue detachments in Yuma, Arizona and Cherry Point, North Carolina conduct hundreds of hoist operations every year perfectly safely.[48] These risks are successfully mitigated by appropriate training.

However, adding more training to the UH-1 aircrew training syllabus would be difficult. Currently, UH-1 aircrew training does not encompass CASEVAC or MEDEVAC procedures, nor do they fly with corpsmen. Though UH-1s have performed such missions in recent combat operations, they were "hasty" missions that were conducted as lifts of opportunity. This will need to change with the retiring of the CH-46, as more training will need to be added to the UH-1 Training and Readiness Syllabus. Unfortunately, UH-1 aircrews are already tasked with 12 different Mission Essential Task Lists (METLs), which may increase as the UH-1 community

absorbs METLs from the CH-46 community.[49] Ultimately, if the Marine Corps does not acquire a different type of helicopter with performance characteristics similar to, or better than, the UH-60 platform, the UH-1Y is the best hope for creating a robust aero medical evacuation program within the Marine Corps. With its speed, armament, and advanced avionics it is capable of performing all types of medical and rescue missions, including CSAR. Thus, it would be possible for the Marine Corps to use the UH-1Y to conduct *all* types of these missions, both medical and rescue. Whether or not the Marine Corps capitalizes on this capability and properly mans, trains, and equips these squadrons appropriately will be indicative of how seriously the Marine Corps cares about these missions and its Marines serving in harm's way.

Conclusion

In recent years the threat America has faced has shifted from a conventional confrontation with the Soviet Union to global terror networks. As such, its military has drastically reorganized its forces. Yet regardless of the type of threat we face, it will invariably involve putting servicemen in danger. And, throughout history, the American military has been innovative in developing the capability to rescue and treat wounded personnel. Once helicopters became a staple of modern conflict, each service has used them to conduct a variety of life saving missions. Yet, the Marine Corps has historically not been as capable as the other services. In today's current combat operations, this makes no sense, especially considering the fact that forces serving in Al Anbar relied on the Marine Corps for CASEVAC. Furthermore, the Marine Corps' expeditionary nature increases the chances that Marine helicopters will be the only assets available to conduct life saving medical or rescue missions for deployed Marines. Thus, greatly increasing its capability in this area could pay substantial dividends in future operations. Additionally, it will also enable the Marine Corps to provide humanitarian and

disaster relief support at home in the wake of any terrorist attacks or natural disasters that occur in the United States. Ultimately, if the Marine Corps is going to "fight in every clime and place" it should be able to provide medical aviation support in every clime and place as well.

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[1] Joint Staff, *Health Service Support*, Joint Publication (JP) 4-02 (Washington, DC: Joint Staff, October 31, 2006), I-6.

[2] Ibid.

[3] The U.S. Navy and U.S. Coast Guard are considered the SAR experts in the United States. The Navy flies with specially trained corpsmen and all of their SAR helicopters are outfitted with medical equipment, an external hoist for lowering and retrieving personnel from the ground or the water, a Forward Looking Infrared (FLIR) system to aid in searching, and direction finding equipment to home in on distress signals. Coast Guard aircraft are configured in a similar fashion, though they do not fly with medical personnel. Instead, their rescue swimmers are also trained as Emergency Medical Technicians (Basic).

[4] A good example of an extremely complex CSAR mission is the rescue of Air Force LtCol Iceal Hambleton during the Vietnam War, a massive operation which required numerous aircraft and took place over eleven days. For a thorough examination of this incident, as well as U.S. Air Force CSAR operations in Vietnam, see *The Rescue of BAT 21* by Darrel D. Whitcomb (Dell Publishing: New York, 1986).

[5] Headquarters U.S. Marine Corps, *Assault Support*, MCWP 3-24 (Washington, DC: U.S. Marine Corps, May 20, 2004), 1-2. The rescue of Air Force Capt Scott O'Grady by Marines was considered a TRAP mission since his location was known.

[6] There is a distinct difference between over water SAR and over land SAR. Over water SAR requires special equipment to maintain a hover with no visual references, as is often the case at night over water. Since all Navy helicopters are expected to operate over water, they are all properly equipped.

[7] Headquarters, U.S. Marine Corps, *Assault Support*, MCWP 3-24 (Washington, DC: U.S. Marine Corps, May 20, 2004), 1-2.

[8] Ironically, despite tasking an organic Marine unit (MAG-39) with providing SAR support, according to MCWP 3-24, "Marine forces currently lack the organic capability to effectively conduct searches when the survivor's location is unknown." This statement also conflicts with the fact that the Marine Corps currently has two squadrons that are assigned to perform SAR duty: one at MCAS Yuma and one at MCAS Cherry Point. These helicopters do not possess any special equipment that would enable more effective searching (the UH-1s at MCAS Yuma do not even have a FLIR, which is standard equipment on all fleet UH-1 aircraft).

[9] HM2 Larry Courtney e-mail interview. Most corpsmen assigned to MAGs are Aerospace Medical Technicians (AVTs), and their primary purpose is to assist Flight Surgeons in conducting flight physicals. As such, there is often a vast range of actual medical knowledge and experience between corpsmen at each MAG.

[10] "498th Medical Company - Air Ambulance", Global Security.Org, http://www.globalsecurity.org/military/agency/army/498med-co.htm (accessed November 27, 2010)

[11] Not only were all coalition forces supported by Marine squadrons, but Iraqi military personnel, police, and civilians were routinely transported and cared for as well.

[12] Most of the information regarding Marine CASEVAC and MEDEVAC operations in Iraq comes from my personal experience. I deployed with HMM-364 on three separate occasions (February 2003-October 2003, February 2005-August 2005, and September 2006-March 2007) and was present for both the initial invasion as well as operations based out of Al Taqaddum. The supporting numerical statistics were pulled from unit command chronologies, with assistance from personnel at the USMC Archives, located at the Gray Research Center.

[13] Col Dr. Ingo Hartenstein. *Medical Evacuation in Afghanistan: Lessons Identified! Lessons Learned?* Paper prepared for the NATO Research and Technology Organization Human Factors and Medicine Panel Specialists Meeting in Seigburg, Germany, December 2008.

[14] See illustration on page 27. The circles denote areas in Afghanistan where a helicopter, flying at 100 knots, would be able to retrieve a patient and transport them to advanced medical care within one hour of being injured.

[15] Andrew N. Pollack, Benjamin Gulli, Les Chatelain, and Chris Stratford, eds., *Emergency Care and Transportation of the Sick and Injured*, 9th Edition, (Sudbury: Jones and Bartlett Publishers, 2005), 279.

[16] Guy S. Strawder, "The Golden Hour Standard: Transforming Combat Health Support," *Joint Forces Quarterly*, issue 81 (2nd quarter 2006): 62.
[17] "Military rethinking 'golden hour' for injuries", *USA Today.com,* August 25, 2009. http://www.usatoday.com/news/military/2009-08-25-military-golden-hour_N.htm (accessed January 26, 2011).
[18] Leanne Bell, "Military's new take on golden hour may impact EMS." *Medicast.com*, August 27, 2009, http://www.mediccast.com/blog/2009/08/27/militarys-new-take-on-golden-hour-may-impact-ems/ (accessed January 26, 2011)/
[19] Guy S. Strawder, "The Golden Hour Standard: Transforming Combat Health Support," *Joint Forces Quarterly*, issue 81 (2nd quarter 2006): 60-67. This article reinforces, with statistics, how critical the Golden Hour is: 90 percent of trauma casualties die within 60 minutes without advanced trauma life support, and 67 percent die within 30 minutes. Thus, if advanced medical care is located closer to the point of injury, transportation requirements may not need to be as robust. However, transportation is still a requirement. Thus, a good combat health support system relies on the appropriate mix of forward-based advanced trauma life support units (such as STPs, SSTPs, and FRSSs) and availability of helicopters for patient movement to and between the appropriate care facilities.
[20] Marine Corps Center for Lessons Learned, *Medical Evacuation (MEDEVAC) Support of Marine Expeditionary Brigade – Afghanistan (MEB-A) Operations*, (Quantico, March 24, 2010), 2.
[21] "M.A.S.H. Medical Helicopters", Century of Flight.net, http://www.century-of-flight.net/Aviation%20history/helicopter%20history/M.A.S.H.%20Medevac%20Helicopters.htm, (accessed 20 December 2010)
[22] J.D. Leipold, "Army to increase medevac support, add new CAB, more UAVs", 7 January 2010, http://www.army.mil/-news/2010/01/07/32603-army-to-increase-medevac-support-add-new-cab-more-uavs/, (accessed November 27, 2010)
[23] CAPT Michael Vengrow, "Saving Lives and Limbs," United States Naval Institute Proceedings, February 2007, 20.
[24] "UH-60Q MEDEVAC," Global Security.org, http://www.globalsecurity.org/military/systems/aircraft/uh-60q.htm, (accessed 20 December 2010)
[25] "Course Prerequisites", United States Army Flight Medic Homepage, http://usasam.amedd.army.mil/_fm_course/prerequisite.htm, (accessed 20 December 2010)
[26] MAJ Brian E. Walsh, "Aeromedical Evacuation Operations in a Combat Environment," Army Aviation, October 2007, 52.
[27] The Geneva Convention of 1949, Convention (I) for the Amelioration of the Condition of the Wounded and Sick in Armed Forces in the Field, Chapter VI, Article 36 states medical aircraft "shall bear, clearly marked, the distinctive emblem prescribed in Article 38." Article 38 defines the emblem of the medical service of armed forces as a "red cross on a white ground." Army Field Manual FM 4-02.4, *Medical Platoon Leader's Handbook*, further clarifies how Army forces will adhere to the Geneva Convention, and in Appendix A, Section A-6 states medical personnel are protected personnel and as such are "authorized to be armed with only individual small arms" and that "the presence of machine guns...in or around a medical unit would seriously jeopardize its entitlement to protected status."
[28] "Heritage of the Combat Search and Rescue Professionals," Air Force Special Operations Command Website, http://www.afsoc.af.mil/library/afsocheritage/afsoccsarheritage.asp, (accessed December 20, 2010)
[29] Ibid.
[30] "CV-22 Factsheet", U.S. Air Force Website, http://www.af.mil/information/factsheets/factsheet.asp?id=3668, (accessed December 21, 2010)
[31] Bruce Rolfsen, "Study: Air Force CSAR should grow, not shrink," Air Force Times, September 11, 2009
[32] Andrew N. Pollack, Benjamin Gulli, Les Chatelain, and Chris Stratford, eds., *Emergency Care and Transportation of the Sick and Injured*, 9th Edition, (Sudbury: Jones and Bartlett Publishers, 2005), 9-11.
[33] Martin Hill, Mike Galarneau, Gerry Pang, Paula Konoske, *Marine Corps CASEVAC: Determining Medical Supply Needs For Long and Short-Range Airborne Casualty Evacuation*, (San Diego: Naval Health Research Center, November 17, 2004), 4.
[34] "PJ Training", Air Force Special Operations Command website, http://www.afsoc.af.mil/specialtactics/pjtraining.asp (accessed 20 December 2010). It should be noted, however, that since Army flight medics and Navy corpsmen receive training in combat trauma medicine, their skill level far exceeds civilian EMT-B and EMT-I standards. Furthermore, many Army flight medics and Navy corpsmen pursue advanced medical training on their own and become nationally registered Paramedics. Thus, they are often exceptionally capable medical personnel and can perform excellent trauma medicine in extreme conditions, just like

Air Force Pararescuemen. Nonetheless, the fact that all Air Force Pararescuemen are initially trained to the Paramedic level, greatly exceeding the initial medical training of Army flight medics and Navy corpsmen, demonstrates how seriously the Air Force takes the medical aspect of the mission.

[35] Bruce Rolfsen, "Study: Air Force CSAR should grow, not shrink," Air Force Times, September 11, 2009

[36] Ibid. According to the article, the study recommended 171 helicopters to meet the requests of service and combatant commanders.

[37] Otto Kreisher, "Is CSAR Really Nothing Special?", Air Force Magazine, November 2009.

[38] Bruce Rolfsen, "Study: Air Force CSAR should grow, not shrink," Air Force Times, September 11, 2009

[39] HM2 Larry Courtney e-mail interview.

[40] When asked why this is important, a corpsmen elaborated by saying that working in the back of a helicopter is just different. Things like loading patients, working with the crew, just knowing where the medical gear is stowed, and setting IVs in a loud, moving, and vibrating aircraft takes practice.

[41] Martin Hill, Mike Galarneau, Gerry Pang, Paula Konoske, *Marine Corps CASEVAC: Determining Medical Supply Needs For Long and Short-Range Airborne Casualty Evacuation*, (San Diego: Naval Health Research Center, November 17, 2004), 5.

[42] Program documentation from Marine Corps Systems Command, Combat Equipment and Support Systems, AMAL 648: Casualty Evacuation System, November 2009

[43] HM2 Larry Courtney e-mail interview.

[44] I contacted the Pentagon in October 2010 via multiple e-mails requesting information regarding Marine Corps MEDEVAC and CASEVAC operations and did not receive replies from most of them. This is the only information I was sent. Since my questions to Marine Corps officials within the Pentagon went unanswered, I was unable to ascertain if the Marine Corps has a different view on this issue and is in the process of implementing changes to equipment, procedures, training, etc...

[45] CAPT Michael Vengrow, "Saving Lives and Limbs," United States Naval Institute Proceedings, February 2007, 20.

[46] Martin Hill, Mike Galarneau, Gerry Pang, Paula Konoske, *Marine Corps CASEVAC: Determining Medical Supply Needs For Long and Short-Range Airborne Casualty Evacuation*, (San Diego: Naval Health Research Center, November 17, 2004), 1.

[47] Marine Corps Center for Lessons Learned (MCCLL) Information Paper, "Medical Lessons and Observations: HASC Questions for the Record," February 5, 2007. In a different MCCLL interview (November 8, 2006, Sgt Welch), an Army medic described an incident regarding a fatal rescue attempt via hoist which resulted in two fatalities when the hoist cable broke. While there was no additional information regarding the specifics of this incident, it certainly demonstrates that hoist operations can be dangerous if not conducted properly. However, with proper training it is possible to rig a rope system (known as a belay setup) within the helicopter that provides a backup to the hoist cable and prevents anyone from falling if the cable breaks. Both MCAS Cherry Point and MCAS Yuma use this technique, as do all Navy inland SAR commands, since its use is mandated by the Navy Search and Rescue Manual (NTTP 3-50.1). This highlights the difference between safe and unsafe rescue techniques and procedures, and shows the need for proper training when conducting hoist operations.

[48] As the USMC SAR Model Manager, I was tasked with inspecting MCAS Yuma's SAR program on a yearly basis. Both MCAS Yuma and MCAS Cherry Point conduct hoist operations on a daily basis with an excellent safety record. It should be noted that MCAS Yuma conducts technical high-angle rescue operations in rugged terrain, day and night, in terrain similar to Afghanistan. This demonstrates that such operations can indeed be done safely, and that there are Marines trained to do so.

[49] E-mail interview with Maj Sean Mitzel, former Search and Rescue Officer in Charge, MCAS Yuma. When asked if the UH-1Y could perform technical high-angle rescues in Afghanistan, Maj Mitzel stated "Absolutely, however, there is the question of training. Most fleet pilots aren't sufficiently trained in hoist operations. In addition, most fleet pilots aren't properly trained in mountainous (high alt) flying. Combing those two operations (high alt/hoist) is one of the most dangerous and demanding flying regimes we could put our pilots through. This could certainly be done but it would require purposeful changes to the T&R and training pipelines. More emphasis should be placed on high/hot/heavy anyway. To be truly proficient at hoisting (especially hoisting live bodies) it takes time and effort. If Y squadrons were to specialize slightly this could be done."

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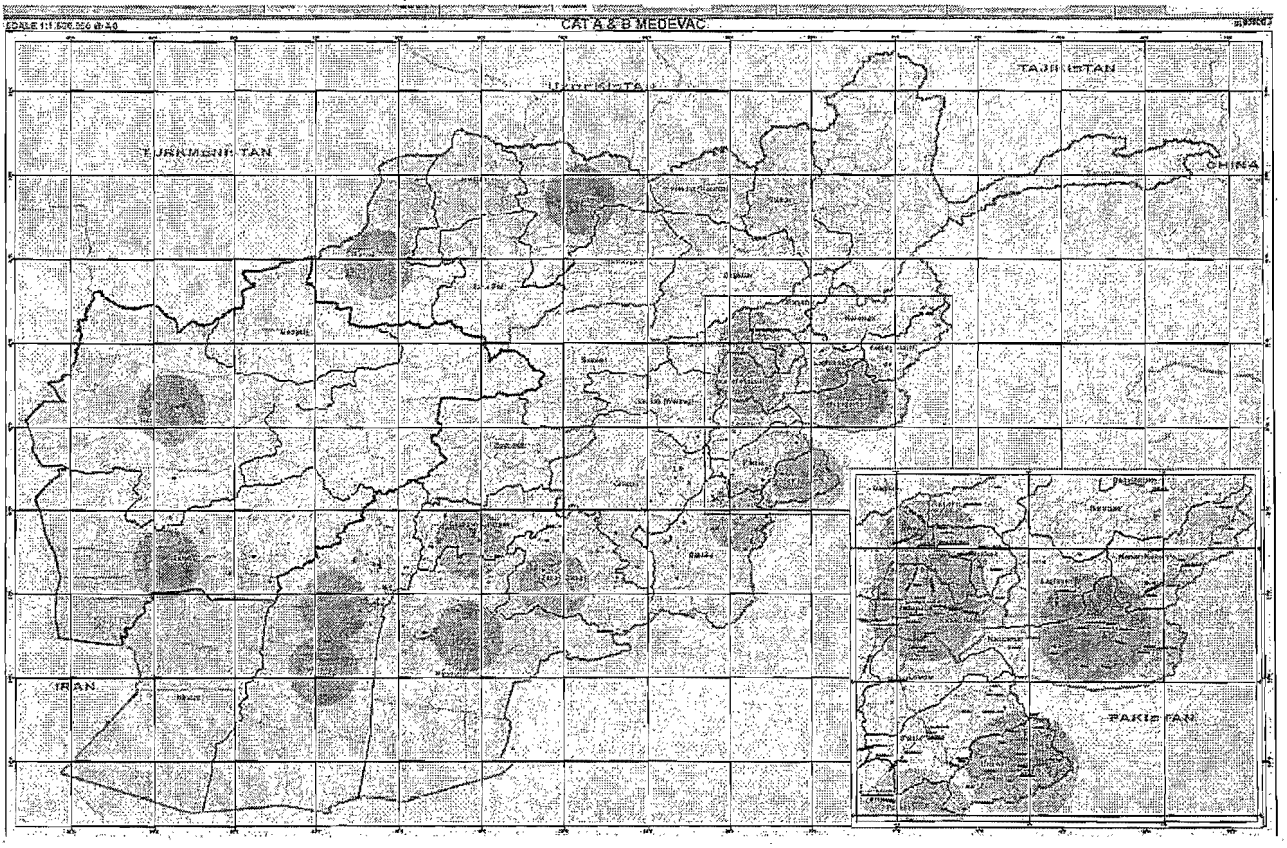
Appendix A: Medical Coverage in Afghanistan

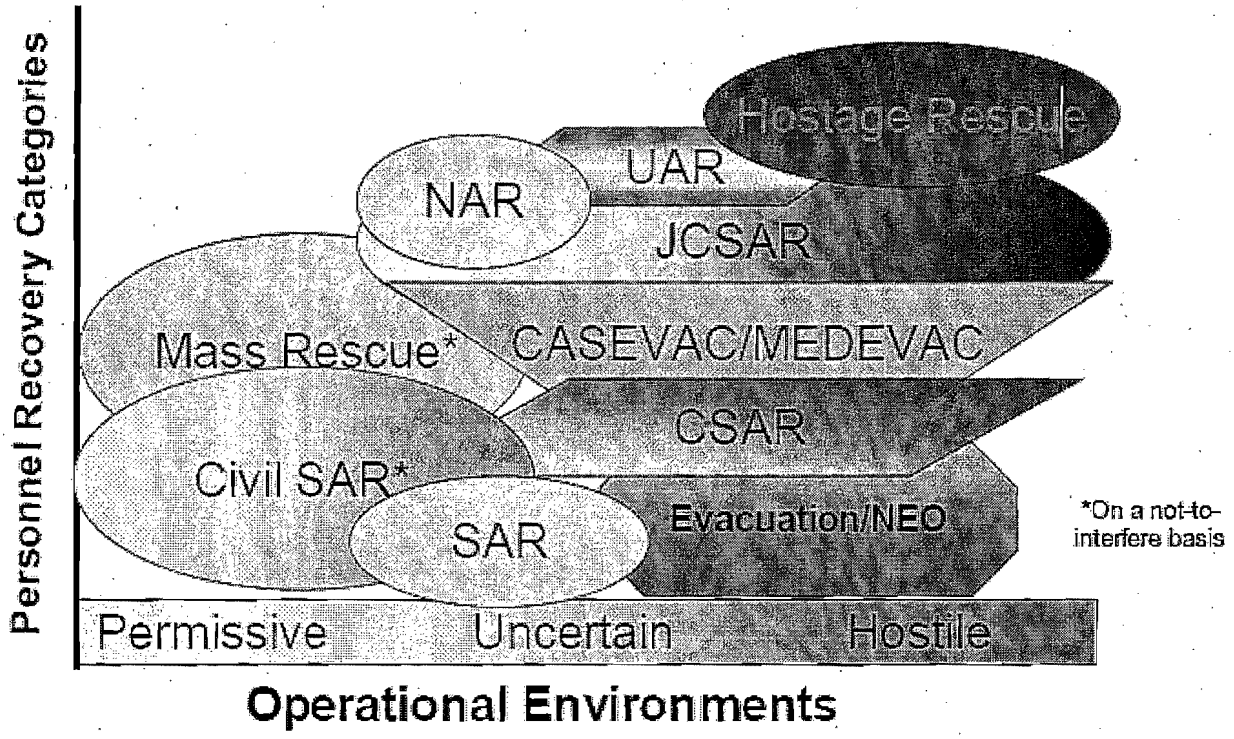
From a paper by Col Dr. Ingo Hartenstein entitled *Medical Evacuation in Afghanistan: Lessons Identified! Lessons Learned?* This paper was prepared for the NATO Research and Technology Organization Human Factors and Medicine Panel Specialists Meeting in Seigburg, Germany, December 2008.



From the paper: "This slide shows where we currently are, when we would only allow one hour from time of wounding to the hospital. It also explains why it is currently just not feasible to cover all areas of interest, even if we could enhance the number of helicopters and medical treatment facilities significantly."

This slide visually depicts the challenges associated with supporting the Golden Hour concept in Afghanistan. Though complete coverage is not feasible, a large number of forward based helicopters and medical facilities can cover the most dangerous areas. Faster aircraft, such as Marine Corps V-22s, can greatly expand medical coverage, though at the cost of not being able to operate in hostile environments.

Appendix B: Personnel Recovery Categories in Different Operational Environments



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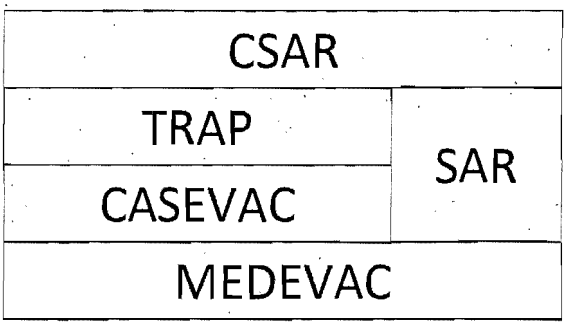
This is a graphical depiction of personnel recovery missions across the full spectrum of operational environments. This report argues that traditionally, each of these missions are viewed as separate entities, but should be seamlessly integrated across the entire spectrum of operational environments. In other words, each service should train its assets, to the maximum extent possible, to be capable of conducting all types of missions in order to provide as much flexibility to operational commanders. However, I feel this illustration is incorrect, in that it combines CASEVAC and MEDEVAC, and places them above CSAR (see Appendix C).

Appendix C: Table of Hierarchy of Missions and List of Mission Requirements



This table depicts a proposed hierarchy of related types of helicopter missions. Any unit capable of doing any of these missions is capable of conducting any of the missions below it. In other words, a CSAR unit is capable of performing all such missions, as is the case with Air Force CSAR assets conducting CASEVAC and MEDEVAC missions in Afghanistan. MEDEVAC requires the least capability, and as such is on the bottom. TRAP, CASEVAC and SAR are placed between CSAR and MEDEVAC, and have slightly different requirements.

Summarized below are mission requirements that support this hierarchy, and can be used to determine what capabilities a given unit needs to perform a given mission. Conversely, the requirements can also be used to show what units would require should they need to be able to perform a specific mission. It should be noted that the base requirement is simply a helicopter with medical equipment and trained medical personnel. From this base requirement, additional requirements are added based on the specific mission.

CSAR: Specialized tactics and training, crew served weapons for self-defense, search capability (FLIR, direction finding equipment, etc...), medical equipment and trained medical personnel

TRAP: Specialized tactics and training, crew served weapons for self defense, medical equipment and trained medical personnel

CASEVAC: Crew served weapons for self defense, medical equipment and trained medical personnel

SAR: Search capability (FLIR, direction finding equipment, etc...), medical equipment and trained medical personnel

MEDEVAC: Medical equipment and trained medical personnel

Brief mission descriptions and differentiating aspects of these missions are described below:

CSAR: Locating, rescuing, and medically treating personnel in a hostile area and transporting them to an appropriate medical facility. May require aircraft with extended range, escorts, and a hoist for mountainous terrain or jungles.

TRAP: Rescuing and medically treating personnel in a hostile area and transporting them to an appropriate medical facility. May require aircraft with extended range, escorts, and a hoist for mountainous terrain or jungles. The primary difference between TRAP and CSAR is that for TRAP missions the location is known, whereas for CSAR the location is unknown, thus requiring search capability.

CASEVAC: Rescuing and medically treating personnel in a hostile area and transporting them to an appropriate medical facility. May require aircraft with extended range, escorts, and a hoist for mountainous terrain or jungles. The primary difference between TRAP and CASEVAC is that TRAP denotes personnel separated from their unit, whereas CASEVAC is responding to a unit request to save injured personnel wounded in a battle or other hostile operation that may be ongoing.

SAR: Locating, rescuing, and medically treating personnel in a non-hostile area and transporting them to an appropriate medical facility. Different equipment would be required for over water SAR and over land SAR. The Marine Corps would have no requirement to be able to conduct over water SAR, since Navy SAR aircraft would be available in amphibious expeditionary operations.

MEDEVAC: Rescuing and medically treating personnel in a non-hostile area and transporting them to an appropriate medical facility.

The primary discriminating factors for these definitions and mission requirements are:

- Hostile versus non-hostile area (hostile requires crew served weapons for self defense)

- Location known versus unknown (unknown location requires search capability)

Minor discriminating factors are:

- Mountainous terrain or jungle (requires hoist capability)

- Land or water recovery (water requires Doppler and other equipment and training)

By breaking down each type of mission into its basic components, it is possible to create clear and concise definitions that can be used to determine how each service or individual unit should man, train, and equip their forces based on their intended operating environment. Ideally, each service or individual unit should strive to attain the capability to conduct all missions, though it may not be possible due to equipment, budget, and personnel constraints. However, based on the fact that Marine units are expeditionary, it should be evident that the Marine Corps should be able to perform, at least to some degree, all of these missions.